



**Welcome**

**To**

**Bangladesh**

**Presentation**

# Status of Agricultural Engineering Research and Development in Bangladesh

*Bangladesh Country Paper*

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# Where is Bangladesh?



## Population, Cropped Area and Contribution of Agriculture to GDP

Year	Net cropped area (mha)	Total cropped area (mha)	Total population (million)	Population in agriculture (%)	Contribution of agri. to GDP (%)
1970	8.81	13.29	71.48	79	59.40
1980	8.45	12.94	87.48	57	54.10
1990	8.35	14.06	111.46	66	36.85
2000	8.13	14.27	123.15	62	25.58
2005	8.02	14.21	150.00	62	23.5

## Production Trend of HYV Rice

Year	Rice production (million ton)		
	Local	HYV	Total
1970	10.86(92%)	0.92(8%)	11.78
1980	8.12(65%)	4.42(35%)	12.54
1990	7.57(43%)	10.13(57%)	17.70
2000	5.35(23%)	17.72(77%)	23.07
2005	3.61(13%)	23.26(87%)	26.87

Other Crops (HYV): Wheat-100%, Maize-100%, Potato-80%

# **Agricultural Engineering R&D: Major Fields**

- 1. Farm Power and Mechanization (FPM)**
- 2. Irrigation & Water Management (IWM)**
- 3. Post-harvest Processing (PHP)**

# Trend of Power Sources in Agriculture

Power sources	Power rating	Year					
		1960	1977	1984	1989	1996	2005
Animal (million)	0.56	9.75	11.16	10.17	11.91	12.00	12.15
Human (million)	0.074	14.04	17.01	17.41	32.57	34.53	36.38
Tractor	30	-	300	400	1000	2000	20,000
Power tiller	8	-	200	500	5000	100,000	300,000
DTW	22	-	4461	15,519	22,448	24,506	27,117
STW	6	-	3045	67,103	223,588	325,360	1,128,99
LLP	6	-	28,361	43,651	57,200	41,816	99,255
Power thresher	7	-	-	600	4000	15,000	155,000
Maize Sheller	7	-	-	-	-	100	700
Farm Power Available (KW/ha)	-	0.24	0.303	0.317	0.501	0.613	1.09

# Farm Power & Mechanization



# **Agricultural Machinery Promotion Organizations**

- **NARS Institutes – BARI, BRRI, BSRI, BARC**
- **University – BAU**
- **International Organizations – CIMMYT, IRRI**
- **NGOs – RDRS, Practical Action (ITDG)**
- **Private Manufacturers- Alim industries, Janata Enterprise, Rahman Engg., etc.**

# Present Status of Mechanization

- **Land preparation** : > 80% mechanical power
- **Sowing/planting** : <10% by machine (Initial stage but encouraging)
- **Irrigation** : >95% by power operated TW/pumps
- **Harvesting** : <10% Rice-wheat harvesting by machine; others mostly manually

# Present Status of Mechanization (Cont.)

- **Threshing** : Rice-wheat > 50% and maize > 90% by machine
- **Winnowing** : Mostly done by manually
- **Drying** : Sun drying at farmers level, commercial farm started using mechanical dryer
- **Milling** : About 100% by machine

# Present Population of Farm Machinery

- **Power tiller : About 300,000**
- **Tractor : About 20,000**
- **Weeder: More than 200,000**
- **Seed cum fertilizer distributor: About 60**
- **Sprayer: 12,50,000**
- **Combine: About 30**
- **Reaper: About 40**
- **Open drum thresher: 100,000-150,000**
- **Closed drum thresher : 40,000 – 50,000**
- **Winnower: About 500**
- **Dryer: About 500 (including rice mill dryer)**

# Trend of Agricultural Mechanization

- **Shifting bullock power to mechanical power**
- **Irrigation facility widely spreading**
- **Threshing/shelling equipment spreading quickly**
- **High demand of harvesting machine**

# Role of Machinery Researchers

- **Prototype development**
- **On farm testing**
- **Performance monitoring and evaluation**
- **Provide manufacturing guidelines**
- **Checking manufacturing standard**
- **Assist promotional activities**

# **Agricultural Machinery Manufacturing**

- ❖ **Farmers demand based**
- ❖ **Unfavorable govt. policy**
- ❖ **Poor manufacturing of agril. machinery**
- ❖ **Absence of adequate design and fabrication guidelines**
- ❖ **Lack of technical facilities, and credit support for local manufacturers**
- ❖ **Absence of product standard and quality certification**
- ❖ **High production cost (material cost)**

# Land Preparation by Power Tiller



- Useful for fragmented land
- Suitable for both dry and wet land preparation (puddling)
- Chinese brand PT is well accepted by the farmers for low cost (US\$ 1000)
- Versatile uses (Irrigation, seeding, transport, milling)

# Power Tiller Operated High Speed Tiller



- **Quality tilth for dry land cultivation**
- **The rotary speed 500-600 rpm**
- **Time saving about 70%**
- **Cost saving about 45%**
- **Yield increase of onion, garlic and potato 15-20%**
- **Very popular for onion and garlic**

# BARI Inclined Plate Seeder



- Uses for maize, wheat, pulses & oilseeds
- Facilitates uniform placement of seeds
- Ensures good germination and emergence of seed
- Saves seed 30-40%

# Power Tiller Operated Seeder (PTOS)



## Advantages

- Tilling, seeding & laddering -3 operations in single pass
- Minimize turn around time
- Residue managed properly
- Seed saved by 20%
- Seeding cost reduced by 35-40%
- Applicable for wheat, mungbean, lentil, chickpea, jute, rice etc.

# Potato Planter



- ❖ Furrow opening, seed placement, seed covering, fertilizer application and earthing up at a time
- ❖ Seed spacing : 25 x 60 cm
- ❖ Planting capacity : 25 dec. per hr
- ❖ Planting cost by machine : US \$ 20 per ha
- ❖ Conventional cost : US \$ 100 per ha

# Potato Digger



- Digs and exposes potatoes above the soil surface
- Save time and cost about 34%
- Harvesting loss is minimum
- Field capacity 0.07 ha/hr
- Price: US \$ 100

# Self-propelled Reaper



- ➊ Easy access to field
- ➋ Lighter weight
- ➌ One operator needed
- ➍ Field capacity 0.20 ha/hr
- ➎ Price: US \$ 900

# Open Drum Power Thresher

- Female workers can operate
- Capacity - 350 to 400 kg/hr
- Locally fabricable
- Straw remains unbroken
- Threshing cost
  - ✓ Machine US \$ 1.7 per ton
  - ✓ Traditional US \$ 2.7 per ton
- Limitation: Operator should wear goggles



# Multi-crop Power Thresher



- ◆ **Threshes rice, wheat and pulses**
- ◆ **Operating mechanism is very simple**
- ◆ **Capacity**
  - ✓ **Wheat: 340 kg/hr**
  - ✓ **Rice: 930 kg/hr**
- ◆ **Price: US \$ 300**

# Maize Sheller



- ❖ Reduces drudgery
- ❖ Operation is simple
- ❖ Ensures timely shelling
- ❖ Capacity :3 ton/hr
- ❖ Price: US \$ 300

# **Mechanization/Irrigation Policy**

**1. No separate policy on mechanization/irrigation**

**2. There are**

- Agriculture policy**
- Water policy**
- Industrial policy**

**3. Mechanization needs**

- Favorable govt. policy**
- Credit for researchers, manufactures, users**
- Duty free raw materials and small machines**
- Tax holiday for manufactures**
- Strong extension and after sale services**

# Financing

- ❏ In the past, govt. gave machines free of cost but it did not work
- ❏ Now govt. exempted tax and gives small subsidy and it popularizes the machineries
- ❏ Some NGOs provide subsidy to popularize machinery
- ❏ Bank loans available to purchase farm machinery
- ❏ Funds to be provided for need based machinery research on competitive basis
- ❏ Partial funds should be provided to the manufacturers specially for newly innovated machineries.

# Impact of Partial Mechanization

- Increased cropping intensity
- Reduced human drudgery and shortage of draft power
- Developed skills and expertise of farmers, local mechanics
- Increased farmers income
- Created new jobs
- Established private machinery workshops
- Reduced rural poverty
- Improved livelihood of the farmers

# Constraints to Agricultural Mechanization

- ❖ Inadequate financial resource mobilization
- ❖ Unfavorable government policy
- ❖ Poor manufacturing of agricultural machinery
- ❖ Absence of active extension service
- ❖ High turn over of skilled manpower in research organization
- ❖ Lack of knowledge and skill for use, repair and maintenance of machinery and irrigation systems
- ❖ Scarcity of spare parts, tools and accessories
- ❖ Inadequate after sale-services

# Conclusions

- ❖ **Farm mechanization is essential for profitable and sustainable agriculture**
- ❖ **Selective mechanization is found to be acceptable and profitable to Bangladeshi farmers**
- ❖ **Farm mechanization helps minimizing yield gap**
- ❖ **Farm machinery need to be extended through DAE, NGOs and manufacturers**
- ❖ **Research on appropriate farm machinery to be strengthened**
- ❖ **Marketing channel of farm machinery to be established**
- ❖ **Regional and International collaboration is necessary**

# Irrigation and Water Management



# Irrigation Promotion Organizations

- ❖ **NARS Institutes – BARI, BRRI, BINA**
- ❖ **Other Public Organizations – BADC, BMDA, BWDB, LGED**
- ❖ **NGOs – RDRS, Proshika**

# Irrigation Development

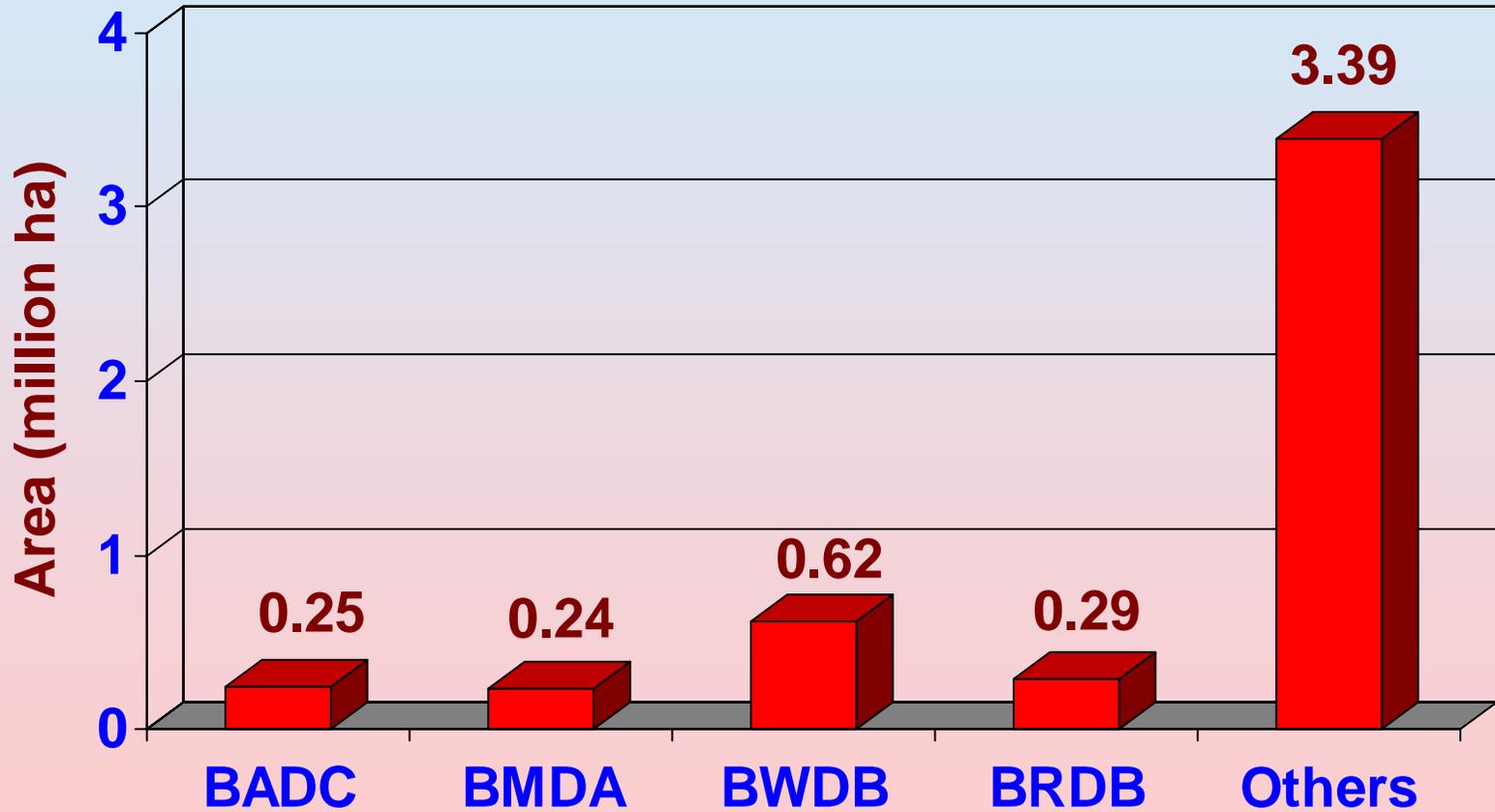
- ❖ **Initially by civil and mechanical engineers**
- ❖ **No knowledge of crops and crop-water requirements**
- ❖ **Expensive infrastructures – big canals, dam, DTW etc.**
- ❖ **High water loss, low irrigation efficiency, low productivity, etc.**

# Irrigated Area Under Different Mechanized Equipment

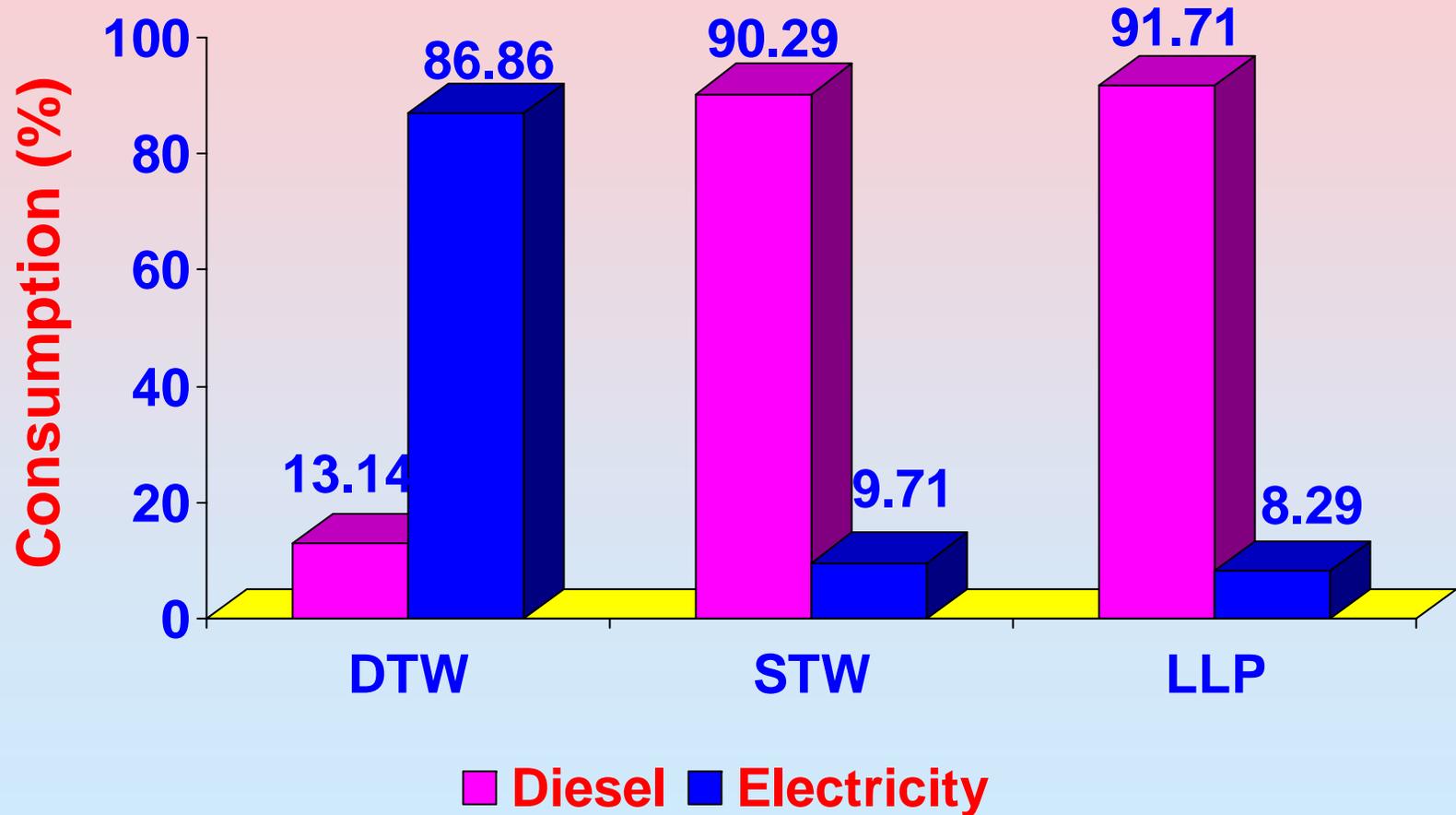
Sl. No	Year	Deep tubewell		Shallow tubewell		Low-lift pump		Total irrig area (mha)
		No.	Area (mha)	No.	Area (mha)	No.	Area (mha)	
1	1962	-	-	-	-	1555	0.03	0.03
2	1970	940	0.01	-	-	17846	0.26	0.27
3	1980	9795	0.24	11280	0.06	37389	0.60	0.90
4	1990	22412	0.45	252500	1.13	56500	0.49	2.07
5	2000	25100	0.52	757100	2.64	71600	0.65	3.81
6	2005	27117	0.65	1128991	3.16	99225	0.84	4.65

**Source: Bangladesh Agricultural Development Corporation (BADC)**

# Agency Wise Area Irrigated



# Energy Use In Irrigation





**Unplanned installation of tube wells**

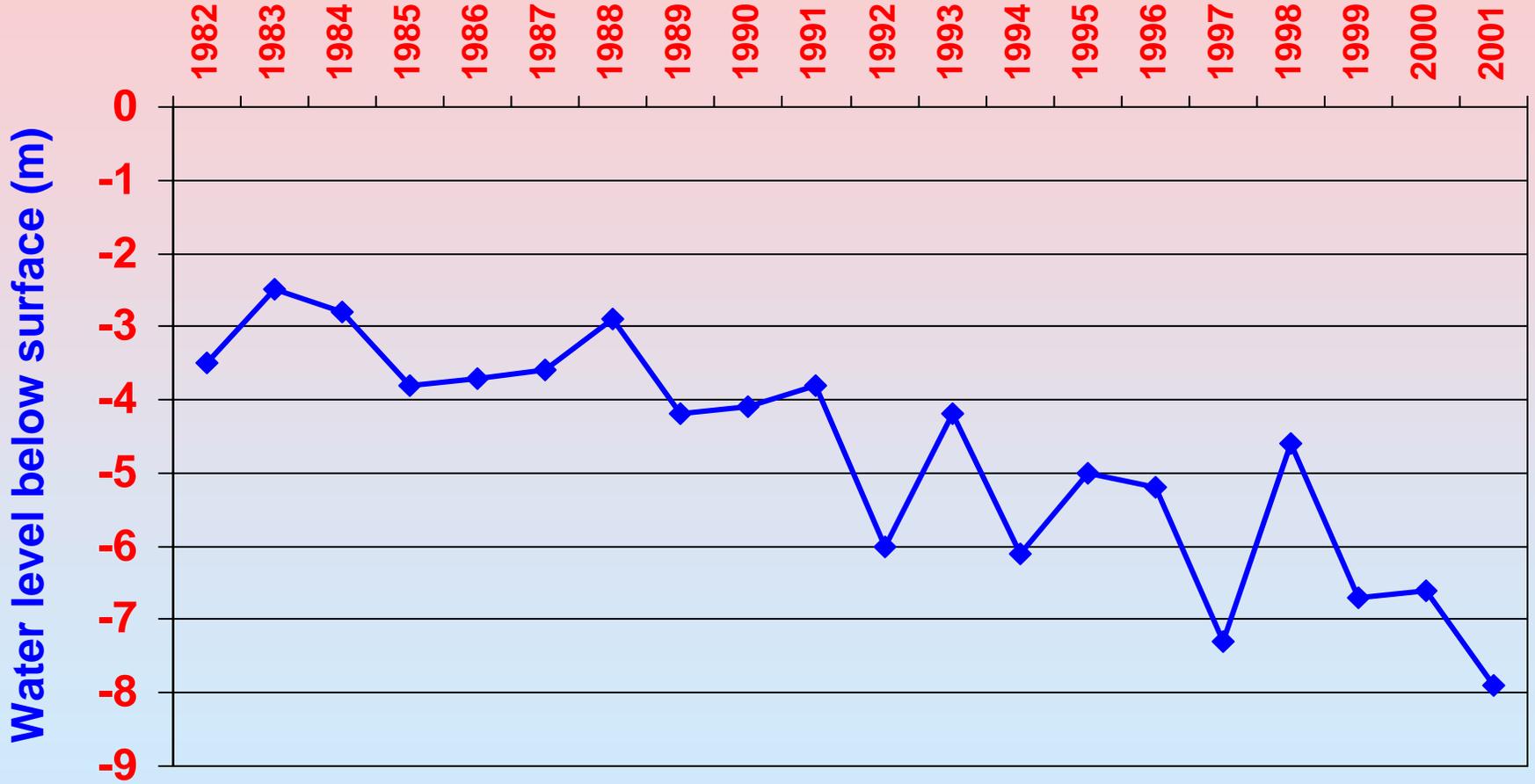


**Poor maintenance of irrigation equipment**



**Poor management of irrigation water**

# Groundwater level depletion in Gazipur



# **Contribution of Agricultural Engineers**

- 1. On-farm water management technologies**
- 2. Crop water requirements and irrigation scheduling of field and horticultural crops**
- 3. Watershed management (not much)**
- 4. Productive irrigated agriculture**

# Crop Yields Under Irrigated and Non-irrigated Conditions

Crop	Yield (t/ha)		
	Non-irrigated farmers practice	Irrigated	
		Farmers practice	Improved practice
Potato	8-10	15-20	25-30
Sweet potato	10-12	20-25	30-35
Mustard	0.6-0.7	1.2-1.5	2.0-2.5
Groundnut	1.0-1.2	1.5-2.0	2.5-3.0
Maize (OP)	0.8-1.2	3.5-4.0	5.0-8.0
Maize (HYV)	3.0-5.0	5.0-8.0	8.0-12.0
Gram	0.7-1.0	1.0-1.5	1.8-2.2
Lentil	0.6-0.8	1.0-1.2	1.5-2.0
Wheat	1.0-1.8	2.0-3.0	3.5-4.0
Local rice (Aus)	1.0-1.5	2.5-3.5	-
HYV Aus	1.5-2.5	3.0-4.0	4.0-5.0
HYV Aman	2.0-3.0	3.0-4.0	4.0-5.0
HYV Boro	-	3.5-4.5	5.0-6.0



**Improved earthen channels by Ag. Engineers**



**Raised bed, mulch and irrigation help  
reduce salinity for crop production**



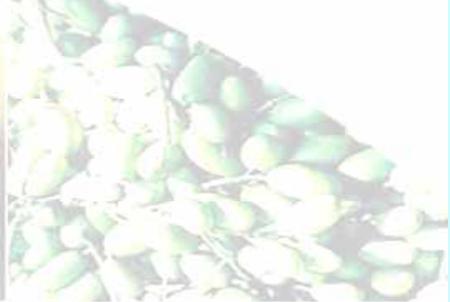
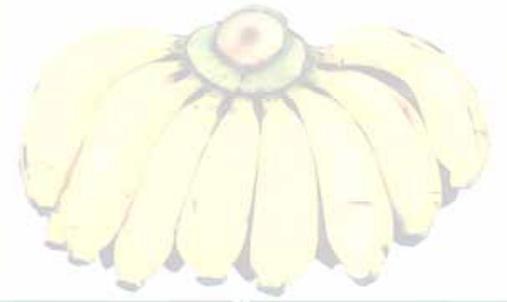
**Locally developed drip systems  
are suitable for small farms**



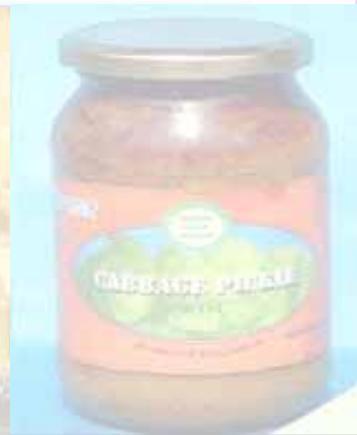
**Papaya irrigation by drip method is profitable**



**Flow diversion device**



# Postharvest Processing



# Production and Postharvest Losses of Crops

Sl. No.	Food crops	Production (million tons)	Postharvest losses (million tons)	Postharvest losses (million Tk.)
1.	Cereals (Rice, wheat, maize etc)	28.38	3.68	18,400.00
2.	Pulses	0.60	0.09	1,200.00
3.	Oil seeds	0.50	0.07	1,190.00
4.	Fruits	1.50	0.45	2,560.00
5.	Vegetables including roots & tubers	6.13	1.84	9,200.00
6.	Sugar cane	6.50	1.30	1625.00
7.	Spices	.33	0.06	-
<b>Total</b>		<b>42.94</b>	<b>7.49</b>	<b>= 34,175.00</b> <b>=US\$ 570 million</b>

# Effect of Food Shortage

- 44% of the peoples live in absolute poverty
- 30 million peoples are ultra poor
- Acute food insecurity is reflected in endemic malnutrition

*In WFS (1996) Bangladesh committed to reduce its malnourished population to half by 2015*

# Constraints to Achieving Food Security

- **Acreage decreasing**
- **High input cost causing yield loss**
- **High Post harvest losses**
  - **Quantitative**
  - **Qualitative**

# Technology Developed

1. Improved storage structures
2. Food processing technologies
  - ❖ Processing food grain
  - ❖ Processing oil seeds
  - ❖ Processing fruit and vegetables, etc.

# Technology Developed so far

## Storage container for cereals, legumes and oil seeds



Poly. Lined earthen motka



Coal tar coated earthen motka



Poly. lined gunny bag



Tin container

# Processing of Fruits and Vegetables into Pickles & Chutney



Garlic pickle



Brinjal pickle



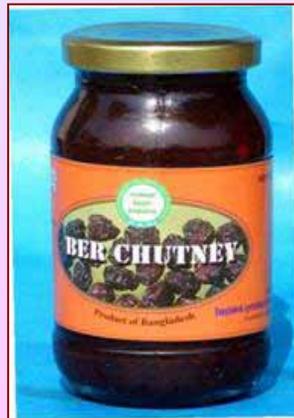
Golden apple pickle



Mixed vegetables pickle



Chalta chutney



Ber chutney



Olive chutney



Golden apple chutney

# Processing of Fruits and Vegetables into Jam and Jelly



Golden apple jelly



Guava jelly



Pineapple jelly



Palmyra palm jam



Mango jam



Mixed fruit jam

# Preservation of Fruits into Sugar Syrup & in Brine Solution



**Jackfruit in sugar syrup**



**Litchi in sugar syrup**



**Pineapple in sugar syrup**



**Golden apple in brine solution**



**Mango slice in brine solution**

# Osmotic Dehydrated Products



**Pineapple**



**Banana**



**Papaya**

# Impact of Technologies

- ☀ Trained people (VDP groups, tribal women and some NGOs) are using these processing technologies as income generation source
- ☀ Several trained groups/persons received awards at national level competitions
- ☀ The improved storage containers already created good impacts. The containers are used to store farmers' seeds safely for long time.

# Recommendations

- ◆ Joint research projects may be undertaken to develop appropriate farm machinery and technologies on water management and agro-processing of fruits and vegetables, which are very essential for present Bangladesh context.
- ◆ Exchange of ideas and experiences with APCAEM member countries through seminar, traveling workshop, etc.

## Recommendations (Contd.)

- ◆ Improve the capacity of stakeholders (producers, traders, users and processors) and service providers (associations, financial institutions and NGOs) in understanding and incorporating the principles and practices in value chain management to the strategies of individual organizations.
- ◆ Collaboration of agro-based enterprises of APCAEM member countries is essential to improve their product quality.

# Thank You

